

# HOUSE PRICES AND UNEMPLOYMENT: A RECENT EVIDENCE FROM POLAND

**Krzysztof DRACHAL**

Faculty of Economic Sciences, University of Warsaw, Poland  
e-mail: k.drachal@mini.pw.edu.pl

**Abstract.** The purpose of this paper is to present the analysis of the relationship between house affordability and unemployment on the regional level in Poland. The affordability is measured by dividing the average house price by the average wage in a region. The period between 2006 and 2015 is analysed. The quarterly data are used. The data were collected from the biggest cities in voivodeships (certain kind of Polish administrative regions). Additionally, one extra city was also examined. As the result, 17 cities were analysed. Both primary and secondary markets were analysed.

**Key words:** property market, real estate market, regional labour market, wages.

## 1. Introduction

In the 1990s, especially in the second half, investors become more interested in the Polish real estate market. Of course, this was because of the transition in Polish economy and corresponding law changes. However, after the initial dynamic beginning of existence of a stock exchange, investors become interested in other kind of assets. In last years, the real estate property prices increased very much. This has happened also in case of the land price. Moreover, such increases have been also observed in many other countries. In case of, for example, US market, many researchers suggested the house price bubble.

Indeed, such conclusions were also presented in case of the Polish real estate market. Moreover, there is an ongoing debate whether real estate prices

correspond somehow reasonably to wages, unemployment and affordability of consumers. The analysis of house prices in Poland can be found in various papers. For example, Belej and Kulesza (2014) applied quite interesting and developed methods (like Chebyshev distance, the damped harmonic oscillator model, etc.) and concluded that it is the capital city which initiates the changes. Even the bifurcation theory was used to model the unexpected changes on the real property market (Belej and Kulesza, 2013; Belej, 2013). A bit more classical approach can be found in the paper of Leszczyński and Olszewski (2014).

In this paper it is tried to present some arguments connected with the problem of affordability in the context of regional labour markets.

## 2. Literature review

The average privately owned real estate owned by a natural person in Poland consists of 52.1 m<sup>2</sup> of useful floor area on average per 1 dwelling. There are 2 523 692 dwellings owned by natural persons. The average area does not vary much between regions. However, Mazovian region (including the capital city Warsaw) is characterised by significantly the highest number of dwellings. For example, there were 472 314 dwellings in Mazovian region as in 2013. Whereas in the same time, the second highest dwelled region was Lower Silesian (including Wrocław) with 290 955 dwellings. The average number of persons in 1 dwelling varies through regions. In Mazovian region it was 2.49, whereas in Subcarpathian (including Rzeszów) it was 3.35 (GUS, 2014).

However, total outstanding residential loans to disposable income of household ratio is rather small in Poland (33.7%) in comparison with other EU countries (79.2%). Total outstanding residential loans to GDP ratio (20.7% in Poland) is also quite small (51.1% in EU 28). Moreover, total outstanding residential loan is 2 563 EUR per capita in Poland and 16 222 in EU 28 (HYPO, 2014).

According to Eurostat (2015) wages are relatively small in Poland. The average is 698 EUR per month, whereas in many EU countries it is over 2 000 EUR. On the other hand, the average net wages increased by over 30% since 2006 in Poland (GUS, 2015a; GUS, 2015b). However, house prices have recently grown faster than incomes in a number of countries (IMF, 2015).

Therefore, it is interesting to consider the relationship between regional unemployment and real property

affordability measured by the real estate price to average wage ratio. Unemployment is an important indicator connected with opportunities of a region and its potential to continue existing development processes in the future. Indeed, it can be observed that unemployment rate is negatively correlated with core prices (Drachal, 2014).

Puga and Overman (2002) suggested that regional labour markets polarize in Europe. Meen (1999) observed in UK that regional house prices are driven by the ripple effect, i.e., the price changes are generated by a certain region and then spread over. Moreover, the role of migration is very significant in this effect. Giussani and Hadjimatheou (1991) analysed long-run time series for regional house prices in UK and confirmed the existence of the ripple effect. They also stressed the role of migrations. Similarly, McCormick (1997) suggested strong relationship between regional unemployment and labour mobility in the UK.

Goodhart and Hofmann (2008) analysed 17 industrialized economies between 1970 and 2006. They found evidence that there is a strong link between house prices and macroeconomic fundamentals. Moreover, shocks affect credit channels much more in house price boom periods.

Holly et al. (2000) analysed the impact of fundamentals such as, for example, real disposable income per capita on house prices in US. They also examined the speed of adjustment of real house prices to macroeconomic disturbances in the regional context. They found cointegration between real house prices and real incomes per capita. Moreover, they found a statistically significant negative relationship between

net borrowing cost and house prices and a statistically significant positive relationship between population growth and real house price changes on the regional level. However, in selected regions certain departures from long-run equilibrium were found. An interesting research on fundamentals and house prices was also done by Nneji et al. (2013).

In last century a certain paradox was observed in UK. Indeed, Tomas (1993) analysed that there is a net outflow of people from areas with high job creation and wages. The outcomes suggested that migrations are motivated by, *inter alia*, level of wages but not by the house prices, if the migration was done due to non-job reasons. However, recent study of Rabe and Taylor (2012) suggests that an unemployed person responds to regional differences in expected wages, whereas an employed one is more sensitive rather to employment opportunities. Indeed, migration play an important role on real estate markets. It can have a significantly negative impact on house prices (Sa, 2014).

Valetta (2013) analysed the house lock hypothesis for US. This hypothesis states that an unemployed homeowner might not want to move to an area with more jobs. This can be so, because he or she would suffer a loss from selling the house. His findings do not support the house lock hypothesis. Adelino et al. (2015) found that there is a positive correlation between house prices and employment in small businesses. On the other hand, such a correlation was not found statistically significant for employment in large companies.

Within the presented context, Vermeulen and van Ommeren (2009) argued that high unemployment is

compensated by lower house prices on the regional level. They examined 142 cities in 12 EU countries and found the evidence supporting this hypothesis. For example, housing was found on average about 3% less expensive in cities characterized by over 10% unemployment. The impact of regional GDP per capita was also found statistically significant.

Therefore, in this paper relationship between real estate prices and unemployment is analysed on the regional level in case of Poland.

### 3. Data and methodology

The analysis is based on quarterly data between 2006 and 2015. Real estate prices were obtained from NBP (2015). Unemployment rate and average wages were obtained from GUS (2015c). All computations were done in R software (Gentleman and Ihaka, 1996; R Core Team, 2014).

The Kendall rank correlation coefficient was computed for 36 data sets containing the real estate prices to average wages ratio and unemployment level from 17 biggest Polish cities (*i.e.*, Białystok, Bydgoszcz, Gdańsk, Gdynia, Katowice, Kielce, Kraków, Lublin, Łódź, Olsztyn, Opole, Poznań, Rzeszów, Szczecin, Warszawa, Wrocław and Zielona Góra). The transaction real estate prices were considered, but both primary and secondary markets were analysed separately. Similar analysis was also done for first differences of the mentioned ratio and unemployment. The number of sets of data (36) comes from 36 quarters taken into the analysis. Indeed, for each period both the Kendall rank correlation coefficient was computed and its statistical significance was tested (Agresti, 2010).

The Kendall rank correlation coefficient was chosen instead of a more common Pearson or Spearman's ones, because no linear relationship was assumed. Moreover, the Kendall one has better statistical properties in case of the distribution, it is less sensitive to error and discrepancies in data and its p-values are more accurate when the sample size is small (as it is in this particular case).

Unemployment was expressed in percentage points. The real estate prices to average wages ratio was computed by dividing a price of 1 square meter in PLN by average gross monthly wage in PLN.

#### 4. Results

First of all, cointegration of house price to wages and unemployment was checked with a help of Johansen test. This particular test was chosen, because it allows to diagnose multiple time-series. At 5% significance level the series are cointegrated (details not reported herein). Both primary and secondary markets were analysed. This confirms the hypothesis that regional house markets in Poland are intensively linked. Indeed, Fig. 1, Fig. 3 and Fig. 4 present time-series. For a legend see Fig. 2. It is clear that the prices follow the common drift.

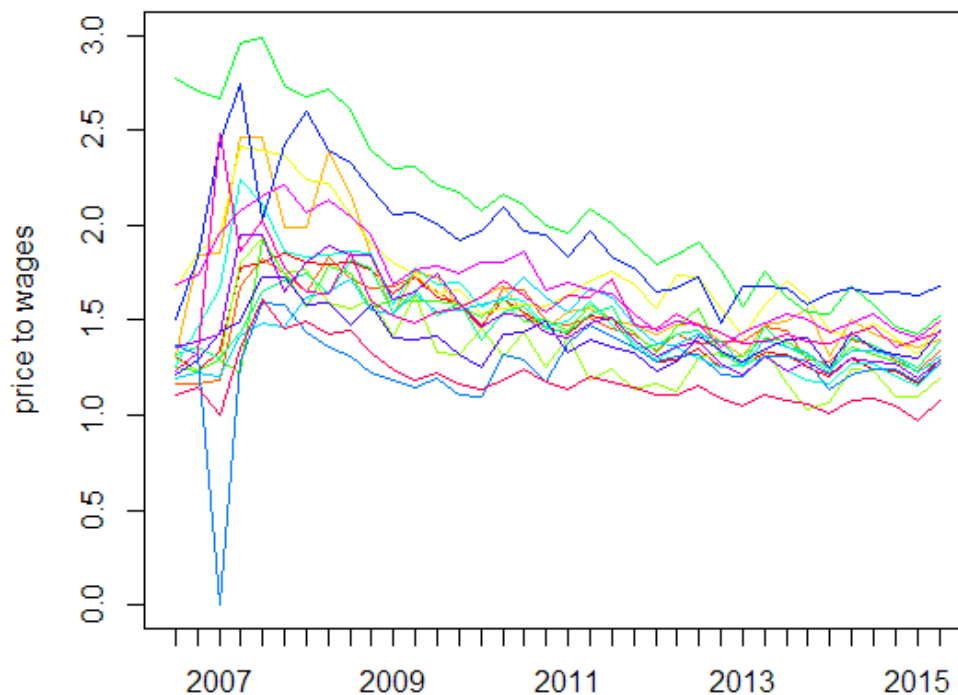


Fig. 1. House prices to wages on the primary market (the legend on Fig. 2)

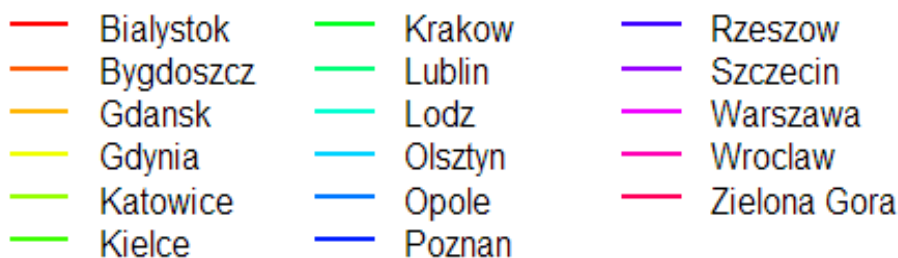


Fig. 2. The legend for Fig. 1, Fig. 3 and Fig. 4

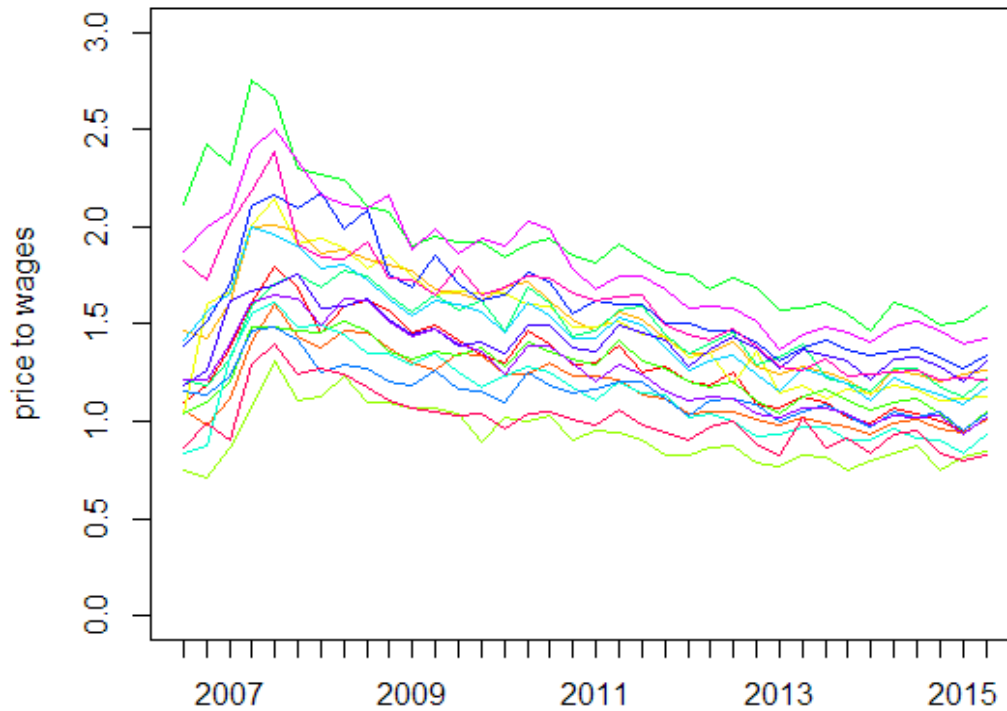


Fig. 3. House prices to wages on the secondary market (the legend on Fig. 2)

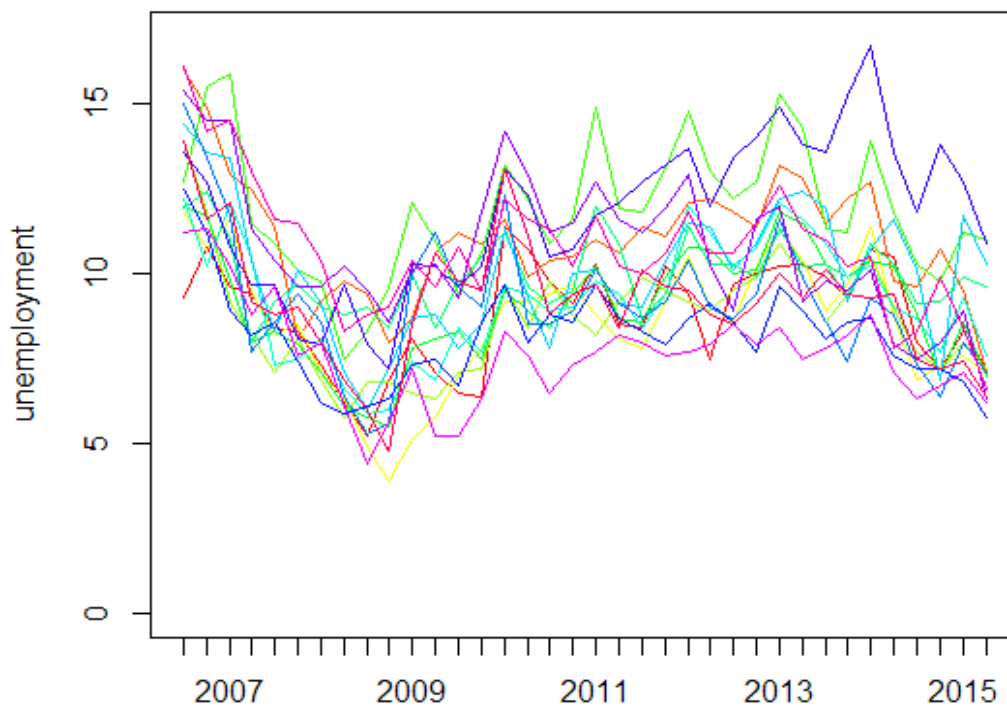


Fig. 4. Unemployment in pp. (the legend on Fig. 2)

Now, in the above context it is interesting to consider the relationship between the unemployment level and house prices to wages ratio for different regions. Fig. 5 presents the scatter-plot of unemployment level and house prices to wages ratio for different

regions. Different color indicate different periods. In other words, the figure presents 36 graphs (different colours correspond to different time periods) of unemployment level and house prices to wages ratio for every 17 considered cities.



Fig. 5. Unemployment in pp. vs. house prices to wages ratio on the primary market (different colours indicate different time periods)



Fig. 6. Unemployment in pp. vs. house prices to wages ratio on the secondary market (different colours indicate different time periods)

**Table 1.** The Kendall rank correlation coefficients and their p-values for the significance test

primary market						secondary market					
time	$\tau$	p-value	time	$\tau$	p-value	time	$\tau$	p-value	time	$\tau$	p-value
1	-0.39	0.03	19	-0.19	0.28	1	-0.07	0.68	19	0.00	1.00
2	-0.32	0.08	20	-0.26	0.15	2	-0.07	0.71	20	-0.10	0.59
3	-0.22	0.23	21	-0.33	0.06	3	-0.17	0.34	21	-0.23	0.20
4	-0.10	0.59	22	-0.21	0.25	4	-0.07	0.71	22	-0.18	0.32
5	-0.08	0.65	23	-0.10	0.59	5	-0.05	0.77	23	-0.08	0.65
6	-0.40	0.03	24	0.16	0.36	6	-0.11	0.53	24	0.04	0.80
7	-0.42	0.02	25	0.03	0.87	7	-0.18	0.32	25	0.03	0.87
8	-0.24	0.19	26	0.06	0.74	8	-0.19	0.28	26	-0.01	0.93
9	-0.16	0.36	27	0.01	0.97	9	-0.19	0.28	27	-0.07	0.71
10	-0.23	0.20	28	0.10	0.56	10	-0.14	0.43	28	0.00	1.00
11	-0.25	0.17	29	-0.04	0.84	11	-0.17	0.34	29	0.02	0.90
12	-0.50	0.01	30	0.03	0.87	12	-0.44	0.01	30	-0.01	0.93
13	-0.33	0.07	31	0.09	0.62	13	-0.31	0.08	31	0.01	0.93
14	-0.16	0.36	32	-0.10	0.56	14	-0.19	0.28	32	-0.06	0.74
15	-0.41	0.02	33	-0.10	0.56	15	-0.44	0.01	33	-0.03	0.87
16	-0.21	0.23	34	0.01	0.97	16	-0.24	0.17	34	-0.04	0.84
17	-0.26	0.15	35	-0.07	0.68	17	-0.16	0.39	35	-0.06	0.74
18	0.01	0.93	36	-0.23	0.20	18	0.01	0.93	36	-0.08	0.65

This figure presents the situation on the primary market. The secondary market is illustrated in Fig. 6. Indeed, from the rough graphical analysis there is some weak indication that the relative house prices (i.e., in a correspondence with wages) are high in regions with low unemployment. On the other hand, smaller job opportunities are compensated by higher house affordability. However, this relationship is quite weak, as the data are much concentrated around average values. Similar conclusions are valid for the secondary market. The above facts are also another reason why to use the Kendall rank correlation coefficient. The computed values of the coefficient itself and p-values of the test of their statistical significance are presented in Table 1.

It can be seen that in most periods there is a negative relationship between unemployment and house prices to wages ratio (75% of cases for the primary market and 81% for the secondary

market). This is in agreement with the hypothesis that smaller job opportunities are on the regional level compensated by higher real property affordability. This conclusion is valid both basing on primary market data and secondary market data. On the other hand, assuming 5% significance level, this relationship is negative and statistically significant only in 14% of analysed time periods for the primary market. However, in none of the period the positive relationship is statistically significant. In case of the secondary market it is only 6% of analysed time periods.

Such a situation can happen if the market is very dynamic. The weak statistical significance can be the result of constant disequilibrium on the market. Indeed, the performed analysis assumes that the relationship between unemployment and house prices to wages ratio happens instantly. In other

words, the variables from the same time period were compared, without any lags. This can be justified by the fact that quarterly data are used, so a quarter is enough time for a market to reflect changes. Yet, as it was seen, some further research could be reasonable to deepen the current analysis.

One of the possibilities is to perform analogous analysis, but for the first differences of the variables. In other words, to analyse the correlation between the quarterly change of unemployment and the quarterly change of house price to wages ratio. The outcomes are reported in Table 2.

**Table 2.** The Kendall rank correlation coefficients and their p-values for the significance test for first differences of variables

primary market						secondary market					
time	$\tau$	p-value	time	$\tau$	p-value	time	$\tau$	p-value	time	$\tau$	p-value
1	NA	NA	19	-0.21	0.25	1	NA	NA	19	0.01	0.93
2	-0.27	0.14	20	-0.42	0.02	2	0.18	0.32	20	-0.17	0.34
3	0.03	0.87	21	0.05	0.77	3	0.00	1.00	21	-0.31	0.09
4	-0.03	0.87	22	-0.24	0.18	4	-0.03	0.87	22	0.06	0.74
5	0.25	0.16	23	-0.11	0.54	5	-0.09	0.62	23	-0.30	0.09
6	-0.08	0.65	24	-0.20	0.27	6	-0.01	0.97	24	-0.08	0.65
7	-0.19	0.30	25	0.00	1.00	7	-0.22	0.23	25	0.33	0.07
8	0.03	0.87	26	0.14	0.43	8	0.01	0.93	26	0.02	0.90
9	0.30	0.09	27	-0.05	0.77	9	-0.08	0.65	27	-0.01	0.97
10	-0.08	0.65	28	-0.01	0.97	10	-0.04	0.84	28	0.02	0.90
11	0.19	0.28	29	0.01	0.93	11	0.03	0.87	29	-0.07	0.68
12	-0.23	0.20	30	-0.18	0.32	12	-0.24	0.17	30	0.25	0.16
13	-0.28	0.13	31	-0.54	0.00	13	0.17	0.34	31	-0.13	0.48
14	-0.14	0.43	32	-0.08	0.65	14	0.20	0.27	32	0.21	0.23
15	0.18	0.32	33	0.12	0.51	15	-0.04	0.80	33	0.12	0.51
16	-0.25	0.17	34	-0.18	0.32	16	-0.38	0.03	34	0.09	0.62
17	-0.21	0.25	35	-0.33	0.07	17	-0.04	0.80	35	-0.18	0.32
18	-0.02	0.90	36	-0.10	0.56	18	0.07	0.71	36	-0.12	0.51

It can be seen that in most periods there is a negative relationship between the change in unemployment and the change in house prices to wages ratio (67% of cases for the primary market and 54% for the secondary market). This is in agreement with the hypothesis that smaller job opportunities are on the regional level compensated by higher real property affordability. However, the confirmation of this conclusion for first differences of variables is now weaker

than if base levels of variables were analysed. On the other hand, assuming 5% significance level, this relationship is negative and statistically significant only in 6% of analysed time periods for the primary market. However, in none of the period the positive relationship is statistically significant. In case of the secondary market it is only 3% of analysed time periods. The corresponding graphs are presented on Fig. 7 and Fig. 8. It should also be



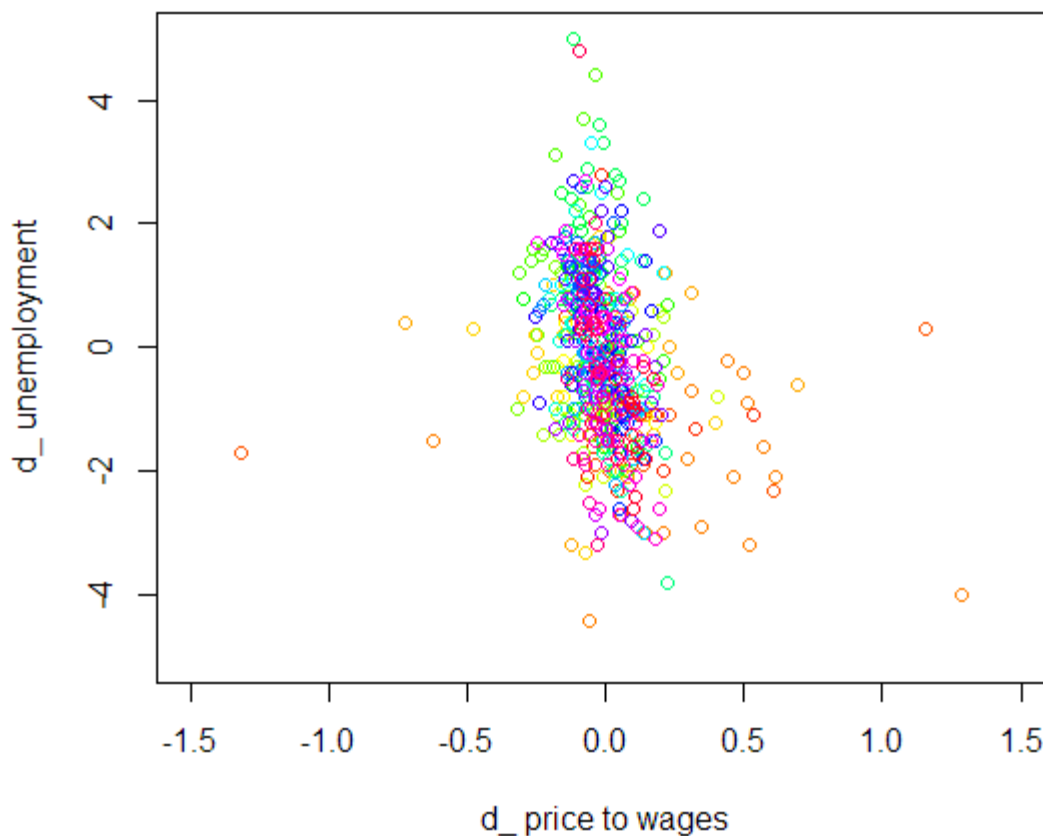
mentioned that prices on the primary market are not always higher than those on the secondary market. In some cities prices on the secondary market are usually higher. Such a situation can be the result of lower developers' activity. The detailed reports are not presented herein, however this information should be stressed here. Indeed, the valuation of a real estate property from the consumer's point of view is a subtle problem (Kuryj-Wysocka and Osiecka, 2014).

One can also ask the following question. Assuming the adjustment takes longer time than a quarter, is there any relationship between unemployment and house prices to wages ratio for particular regions. For example, is the correlation of house affordability and unemployment change different in regions which during the analysed period had on average higher

unemployment than in those regions which during the analysed period had on average lower unemployment.

Indeed, regional unemployment is a significant determinant of regional house prices. Moreover, it affects house prices more in regions with lower average wages than in regions with high average wages. Simultaneously, regions of high unemployment are characterized by low average wages and vice versa (Drachal, 2014; Leszczyński and Olszewski, 2014).

In Fig. 9 the Kendall rank correlation coefficient between house price to wages ratio and unemployment vs. the average unemployment was presented for each region. The negative relationship is quite clearly seen. The similar conclusion is valid for the secondary market, presented in Fig. 10.



**Fig. 7.** Change in unemployment in pp. vs. change in house prices to wages ratio on the primary market (different colours indicate different time periods)

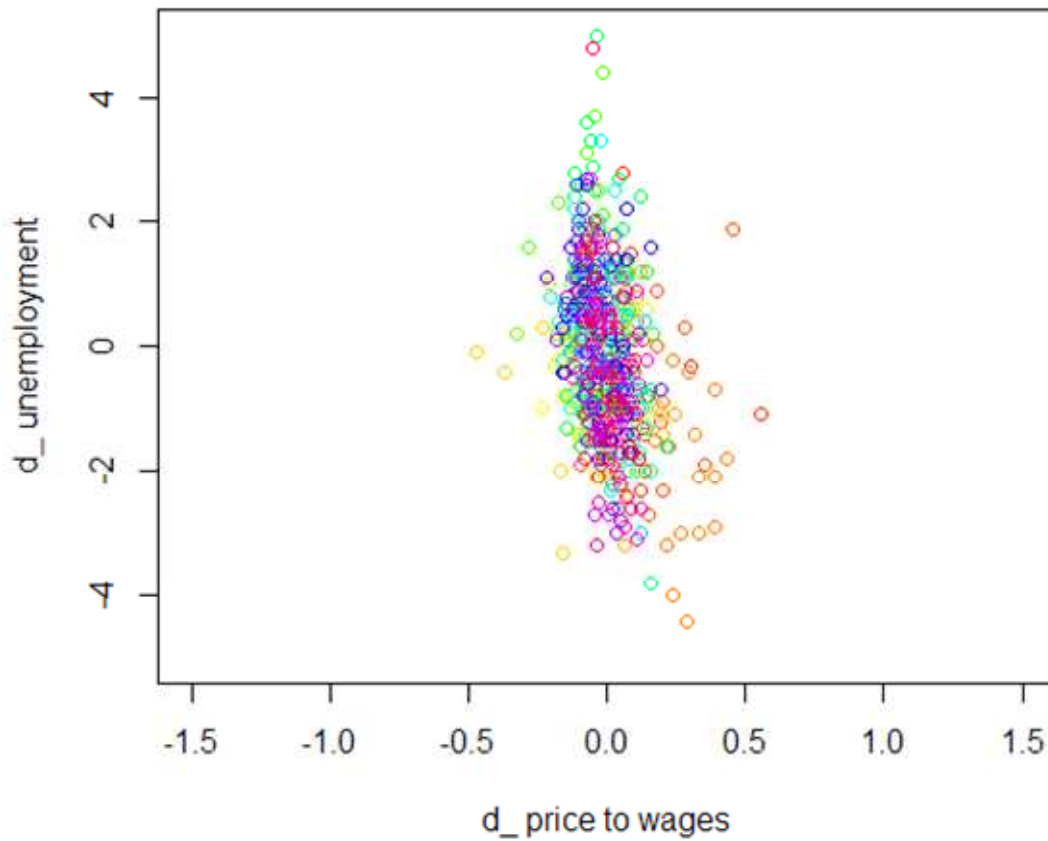


Fig. 8. Change in unemployment in pp. vs. change in house prices to wages ratio on the secondary market (different colours indicate different time periods)

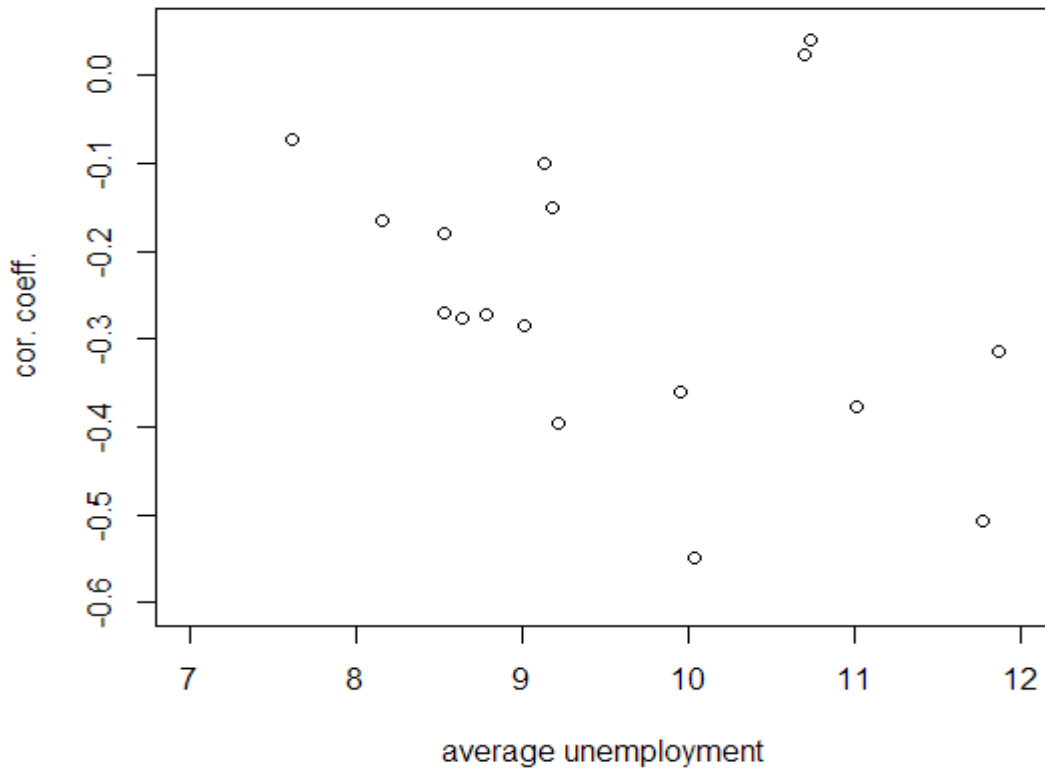


Fig. 9. Correlation coefficient between house prices to wages ratio and unemployment vs. the average unemployment (primary market)

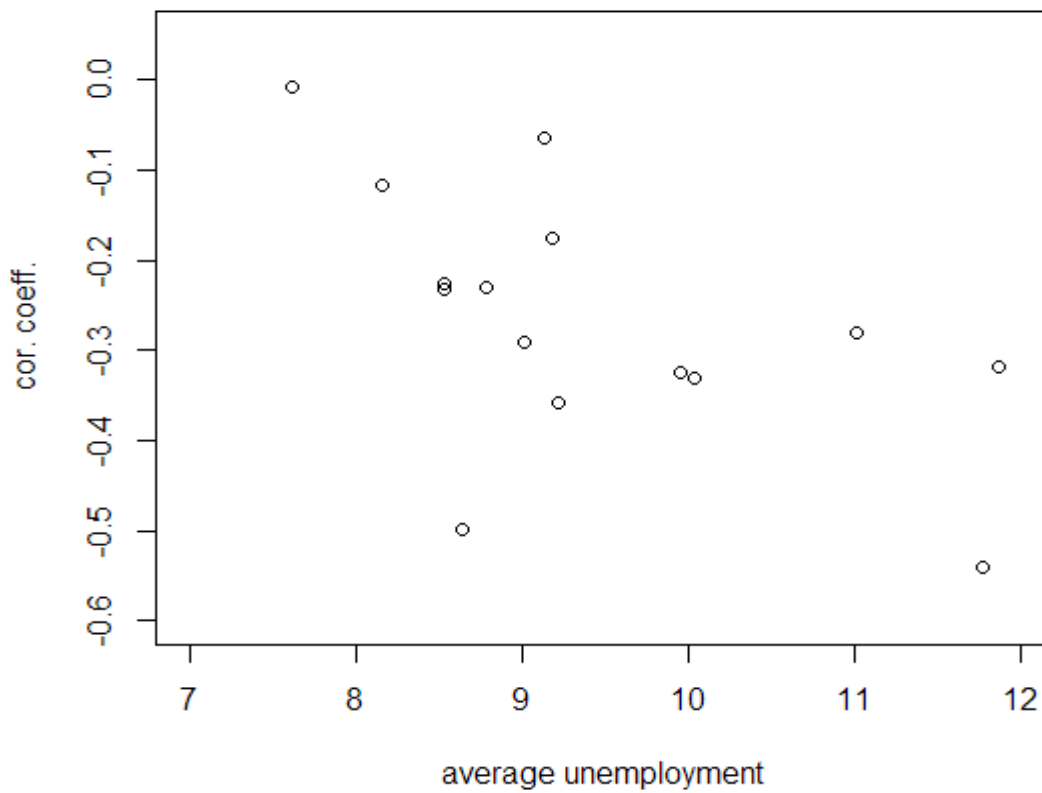


Fig. 10. Correlation coefficient between house prices to wages ratio and unemployment vs. the average unemployment (secondary market)

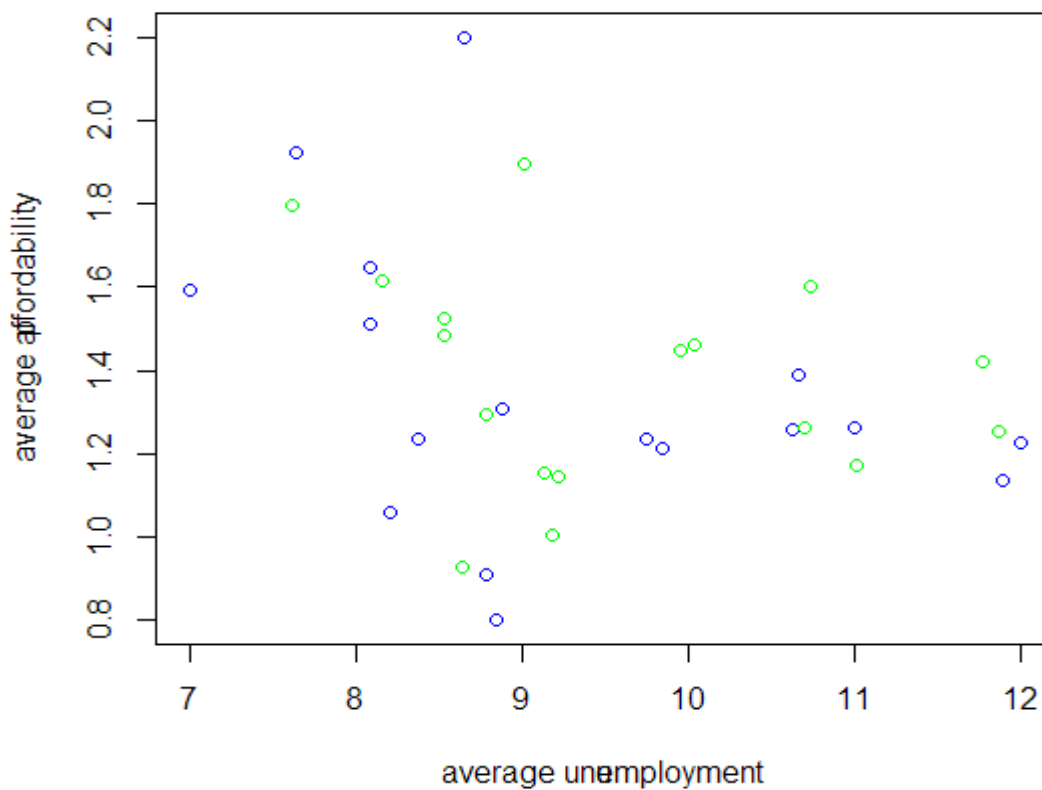


Fig. 11. Average house prices to wages ratio vs. average unemployment (the primary market in blue, the secondary market in green)

In Table 3 the exact values of this coefficient are presented and p-values for the significance test of its values. In case of the primary market this coefficient is negative in 88% of cities. If it is positive, it is not significant at 5% level. In 59% it is both negative and statistically significant at 5% level. In case of the secondary market just in one case (i.e., Wrocław) it is both positive and significant. However, it is also negative in 88% of cities and in 65% of cities it is both negative and statistically significant. Therefore, the outcomes presented in Fig. 9 and Fig. 10 lead to the expected conclusion. Not only an increase in unemployment level is connected with increase in house affordability and vice versa in most regions, but regions with generally high unemployment more sensitive to this relationship.

Therefore, in Fig. 11 the average unemployment vs. average house prices to wages ratio is presented for the analysed regions, both for the primary and the secondary market.

Indeed, on both the primary and the secondary markets it can be observed that house prices to wages ratio is higher in regions with low unemployment and vice versa. Therefore, it is some kind of a support of the hypothesis that there is a compensation of regional unemployment in housing markets in Poland. However, the Kendall rank correlation coefficient between the average unemployment and average house prices to wages ratio is not statistically significant both on the primary and the secondary market (p-values are 0.13 and 0.20 respectively). Yet, the coefficient itself is -0.27 for the primary market and -0.23 for the secondary market.

**Table 3.** Correlation coefficient between house prices to wages ratio and unemployment and p-values of its significance test

city	primary market		secondary market	
	$\tau$	p-value	$\tau$	p-value
<b>Białystok</b>	-0.27	0.02	-0.23	0.05
<b>Bydgoszcz</b>	-0.38	0.00	-0.28	0.02
<b>Gdańsk</b>	-0.27	0.02	-0.23	0.05
<b>Gdynia</b>	-0.18	0.12	-0.23	0.05
<b>Katowice</b>	-0.28	0.02	-0.50	0.00
<b>Kielce</b>	-0.31	0.01	-0.32	0.01
<b>Kraków</b>	-0.29	0.01	-0.29	0.01
<b>Lublin</b>	-0.36	0.00	-0.32	0.01
<b>Łódź</b>	-0.40	0.00	-0.36	0.00
<b>Olsztyn</b>	-0.55	0.00	-0.33	0.00
<b>Opole</b>	-0.10	0.40	-0.06	0.59
<b>Poznań</b>	-0.16	0.16	-0.12	0.33
<b>Rzeszów</b>	-0.51	0.00	-0.54	0.00
<b>Szczecin</b>	0.02	0.84	0.13	0.27
<b>Warszawa</b>	-0.07	0.54	-0.01	0.95
<b>Wrocław</b>	0.04	0.73	0.26	0.03
<b>Zielona Góra</b>	-0.15	0.20	-0.18	0.13

### 5. Conclusions

In this research it was found that there exists a certain compensation of regional unemployment in the Polish regional housing markets. In other words, house prices are higher with respect to average wages in regions with low unemployment and vice versa. On the other hand, in regions with high unemployment the correlation between house prices to wages and unemployment is smaller than in the regions with small unemployment. The outcomes generally confirm the hypothesis of the compensation, but the support is quite weak. In the text certain directions for future, more detailed, researches were suggested. Indeed, the analysed sample is quite small and this problem cannot be overcome now, because real estate market is quite young in Poland. However, one can, for example, repeat the current research with different methods. For example, other correlation coefficients can be applied. Moreover, a potential non-linear relationship can be examined in more detail.

### REFERENCES

- Agresti A. (2010), *Analysis of Ordinal Categorical Data*, Wiley, New York.
- Adelino M., Schoar A., Severino F. (2015), *House prices, collateral, and self-employment*, *Journal of Financial Economics* **117**: 288-306.
- Belej M. (2013), *Catastrophe theory in explaining price dynamics on the real estate market*, *Real Estate Management and Valuation* **21**: 51-61.
- Belej M., Kulesza S. (2013), *Modeling the real estate prices in Olsztyn under instability conditions*, *Folia Oeconomica Stetinensia* **11**: 61-72.
- Belej M., Kulesza S. (2014), *Similarities in time-series of housing prices on local markets in Poland*, *Real Estate Management and Valuation* **22**: 45-53.
- Drachal K. (2014), *Property prices and regional labor markets in Poland*, *Singidunum Journal of Applied Sciences* **11**: 5-15.
- Eurostat (2015), *Wages and labour costs*, [http://ec.europa.eu/eurostat/statistics-explained/index.php/Wages\\_and\\_labour\\_costs](http://ec.europa.eu/eurostat/statistics-explained/index.php/Wages_and_labour_costs)
- Gentleman R., Ihaka R. (1996), *R: a language for data analysis and graphics*, *Journal of Computational and Graphical Statistics* **5**: 299-314.
- Giussani B., Hadjimatheou G. (1991), *Modeling regional house prices in the United Kingdom*, *Papers in Regional Science* **70**: 201-219.
- Goodhart C., Hofmann B. (2008), *House prices, money, credit, and the macroeconomy*, *Oxford Review of Economic Policy* **24**: 180-205.
- GUS (2014), *Housing economy in 2013 r.* [in Polish], Główny Urząd Statystyczny, Warszawa.
- GUS (2015a), *Average monthly gross wage and salary in national economy (1950-2014)*, <http://stat.gov.pl/en/topics/labour-salaries/working-employed-wages-and-salaries-cost-of-labour/average-monthly-gross-wage-and-salary-in-national-economy-1950-2014,2,1.html>
- GUS (2015b), *Yearly price indices of consumer goods and services from 1950*, <http://stat.gov.pl/en/topics/prices-trade/price-indices/price-indices-of-consumer-goods-and-services/yearly-price-indices-of-consumer-goods-and-services-from-1950/>
- GUS (2015c), *Local Data Bank*, [http://stat.gov.pl/bdlen/app/strona.html?p\\_name=indeks](http://stat.gov.pl/bdlen/app/strona.html?p_name=indeks)
- Holly S., Pesaran M.H., Yamagata T. (2010), *A spatio-temporal model of house prices in the USA*, *Journal of Econometrics* **158**: 160-173.
- HYPO (2014), *A Review of Europe's Mortgage and Housing Markets*, European Mortgage Federation, Brussels.
- IMF (2015), *Global Housing Watch*, <http://www.imf.org/external/research/housing>
- Kuryj-Wysocka O., Osiecka A. (2014), *Determinants of valuable area in the dwelling property market illustrated with an example of Olsztyn* [in Polish], *Świat Nieruchomości* **89**: 13-20.
- Leszczyński R., Olszewski K. (2014), *Panel analysis of home prices in the primary and secondary market in 17 largest cities in Poland*, MPRA Paper **59017**, <https://mpra.ub.uni-muenchen.de/59017>
- McCormick B. (1997), *Regional unemployment and labour mobility in the UK*, *European Economic Review* **41**: 581-589.

- 
- Meen G. (1999), *Regional house prices and the ripple effect: A new interpretation*, *Housing Studies* **14**: 733-753.
- NBP (2015), *House Prices Database*, [http://nbp.pl/publikacje/rynek\\_nieruchomosci/ceny\\_mieszkan.xls](http://nbp.pl/publikacje/rynek_nieruchomosci/ceny_mieszkan.xls)
- Nneji O., Brooks C., Ward C.W.R. (2013), *House price dynamics and their reaction to macroeconomic changes*, *Economic Modelling* **32**: 172-178.
- Puga D., Overman H.G. (2002), *Unemployment clusters across Europe's regions and countries*, *Economic Policy* **17**: 115-147.
- Rabe B., Taylor M.P. (2012), *Differences in opportunities? Wage, employment and house-price effects on migration*, *Oxford Bulletin of Economics and Statistics* **74**: 831-855.
- R Core Team (2014), *R: A Language and Environment for Statistical Computing*, R Foundation for Statistical Computing, <http://www.R-project.org>
- Sa F. (2014), *Immigration and house prices in the UK*, *The Economic Journal* **125**: 1393-1424.
- Tomas A. (1993), *The influence of wages and house prices on British interregional migration decisions*, *Applied Economics* **25**: 1261-1268.
- Valetta R.G. (2013), *House lock and structural unemployment*, *Labour Economics* **25**: 86-97.
- Vermeulen W., van Ommeren, J. (2009), *Compensation of regional unemployment in housing markets*, *Economica* **76**: 71-88.
- 

**Received:** 8 October 2015 • **Revised:** 9 November 2015 • **Accepted:** 11 November 2015